Missouri Department of Natural Resources
Water Pollution Control Program

Total Maximum Daily Loads (TMDLs)

for

St. Francis River
St. Francois County, Missouri

Completed: December 22, 2005
Approved: February 1, 2006

Two Total Maximum Daily Loads (TMDLs)
For the St. Francis River
Pollutants: Biochemical Oxygen Demand (BOD) and Ammonia (NH_3)

Name: St. Francis River

Location: Near Farmington in St. Francois County, Missouri

Hydrologic Unit Code (HUC): 8020202-010003

Water Body Identification (WBID): 2835

Missouri Stream Class: P [1]

Beneficial Uses:
- Livestock and Wildlife Watering
- Irrigation
- Protection of Aquatic Life
- Protection of Human Health associated with Fish Consumption
- Cool Water Fishery
- Whole Body Contact Recreation (e.g., Swimming)
- Boating and Canoeing (This will be renamed "Secondary Contact Recreation" by 1/1/06)

Size of Impaired Segment: 3 miles

Location of Impaired Segment: From SE ¼ Section 11, T35N, R5E (upstream) to NW ¼ NE ¼ Section 19, T35N, R6E (downstream)

Pollutants: Biochemical Oxygen Demand (BOD) and Ammonia

Pollutant Source: Farmington West Wastewater Treatment Plant

Permit Number: Missouri State Operating Permit No. MO-0040312 [2]

TMDL Priority Ranking: High

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[1] Class P streams maintain flow even during drought conditions. See Missouri Water Quality Standards (WQS) 10 CSR 20-7.031(1)(F). The WQS can be found at the following uniform resource locator (URL): http://www.dnr.mo.gov/env/wpp/rules/index.html#Chap7
[2] The state permitting system is Missouri's program for administering the National Pollution Discharge Elimination System (NPDES) program.

1. Background and Water Quality Problems

Area History[3]:

Farmington's roots go back to 1798 when William Murphy crossed the Mississippi River into Spanish Territory looking for a place to bring his family. Native Americans familiar with the area guided him to a perfect spot next to a spring. His decision made, he obtained a Spanish land grant and permission to start a settlement along the St. Francois River (now spelled St. Francis). Unfortunately, Murphy died while returning to Kentucky for his wife, their children and grandchildren.

Sarah Barton Murphy and her sons decided to go ahead with her husband's plans and Murphy's Settlement was established a year or so later. Despite many hardships and difficulties, the new community thrived. Sarah Barton Murphy is also credited with organizing the first Protestant Sunday school west of the Mississippi. Descendents of the Murphy family still live in Farmington and are active in the community.

The Louisiana Purchase brought the territory into the United States. When the state of Missouri was created, David Murphy donated 52 acres for the development of a county seat for the about-to-be-formed St. Francois County. This same tract of land is currently the heart of Farmington's downtown business district.

St. Francois County was coveted for its lead production by both sides during the Civil War. It was also used as a staging area for troops out of St. Louis. Despite the heavy concentration of Union soldiers, a notorious Confederate guerilla leader, Sam Hildebrand, managed to commandeer the St. Joe Lead Mines. The guerillas held out for several weeks while manufacturing lead for General Sterling Price's invasion of Missouri. Afterwards, Price ordered the furnaces blown up so that they would not fall into federal hands. One of Hildebrand's many local hideouts, a cave in St. Francois State Park, still bears his name.

Land Use and Soils:

The upper portion of the St. Francis River flows across relatively flat terrain developed in Cambrian-aged dolomites. Land use is primarily forests and pasture (see Land Use Appendix A). Stream gradients are low and streams are characterized by relatively long, deep pools. During dry weather, water movement in the St. Francis is exceedingly slow. Most of the riparian zone along this portion of the St. Francis is forested, so nutrient levels and algal production are fairly low. The river flows through the Crider-Fourche-Nicholson soil association that is part of the Farmington Plain. This is a broad rolling plain that separates the drainage areas of the north flowing Big River from the south flowing St. Francis (Appendix B – Upper St. Francis River Watershed). The soil association is deep, gently to strongly sloping, and well to moderately-well drained.

Defining the Problem:

The Farmington West Wastewater Treatment Plant (WWTP) discharges wastewater into a 0.4 mile long unnamed tributary of the St. Francis River. The tributary is unclassified and drains an area of approximately 3,500 acres. The land use in the tributary is about 21 percent urban, 64 percent agricultural and 15 percent forest. In 1990, the WWTP was upgraded from 0.72 to 1.2 million

[3] Farmington-City of Tradition and Progress, http://fxnet.missouri.org/econdev/lochist/htm and The Civil War, St. Francois county, Missouri, http://rosecity.net/civilwar.stfc.html

gallons per day (MGD or 1.86 cubic feet per second) to accommodate greater influent loads. The Missouri Department of Natural Resources (the department) was concerned that the increased volume of effluent might cause exceedences of the instream water quality standards applicable to the St. Francis River during low flow conditions.

As a result, water quality monitoring was conducted in July 1992, and exceedences of both dissolved oxygen and ammonia water quality standards were found in the St. Francis River below the Farmington West WWTP. The department's Environmental Services Program (ESP) conducted intensive water quality studies of the Farmington West WWTP receiving stream and the St. Francis River on Aug. 6-8, 1996 and July 23-24, 1997 (see Water Quality Data in Appendix C.2). These studies documented exceedences of dissolved oxygen and ammonia standards in at least one mile of the St. Francis River downstream of the Farmington West WWTP and also low dissolved oxygen concentrations on the St. Francis just upstream of the wastewater plant. In August 1999, the department conducted an investigation of possible sources for the low dissolved oxygen (DO) levels in the St. Francis River. No nonpoint sources of low DO were found upstream of the confluence of the tributary conveying the WWTP effluent and the St. Francis River. One small discharge was identified, but is not considered to contribute to the problem (See Section 5 for information on Farmington Manor Lagoon). Initially, the observed upstream DO levels were believed to be normal for this river during summer low flow periods. However, sampling results from 2001 did not support this assumption. On the tributary upstream of the wastewater treatment outfall, dissolved oxygen ranged from 4.1 to 9.4 mg/L (Appendix C.2 Site #2), and on the St. Francis above the confluence with the tributary (Site #1), it ranged from 4.7 to 6.8 mg/L.

The results of the 1996 and 1997 field studies were used to derive new permit limits and the WWTP was again upgraded. This upgrade was completed Nov. 22, 2001, at a cost of $4.8 million dollars. The design capacity of the new facility is 2.4 MGD compared to the old capacity of 1.2 MGD. Construction permit details may be found in Appendix F. The new permit limits went into effect March 1, 2002 and were based on achieving water quality standards in St. Francis River. More data were gathered in a regularly scheduled water quality study in 2001 and the model rerun in 2002. The results of this were modeling were considered inconclusive since they were based on data gathered before the new upgrades went into effect. Therefore, data were collected yet again in 2004. See Section 3. Load Capacity for the discussion.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Targets

Beneficial Uses:
The beneficial uses of the St. Francis River, WBID 2835, are:
- Livestock and Wildlife Watering
- Irrigation
- Protection of Aquatic Life
- Protection of Human Health associated with Fish Consumption
- Cool Water Fishery
- Whole Body Contact Recreation (e.g., Swimming)
- Boating and Canoeing (This will be renamed “Secondary Contact Recreation” by 1/1/06)

The use that is impaired is Protection of Aquatic Life. The designated (beneficial) uses and stream classifications may be found in the Water Quality Standards at 10 CSR 20-7.031(1)(C), (1)(F) and table H.

Anti-degradation Policy:
Missouri's Water Quality Standards include the U.S. Environmental Protection Agency (EPA) "three-tiered" approach to anti-degradation, and may be found at 10 CSR 20-7.031(2).

Tier 1 – Protects existing uses and provides the absolute floor of water quality for all waters of the United States. Existing instream water uses are those uses that were attained on or after Nov. 29, 1975, the date of EPA's first Water Quality Standards Regulation, or uses for which existing water quality is suitable unless prevented by physical problems such as substrate or flow.

Tier 2 – Protects the level of water quality necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water in waters that are currently of higher quality than required to support these uses. Before water quality in Tier 2 waters can be lowered, there must be an antidegradation review consisting of: (1) a finding that it is necessary to accommodate important economical or social development in the area where the waters are located; (2) full satisfaction of all intergovernmental coordination and public participation provisions; and (3) assurance that the highest statutory and regulatory requirements for point sources and best management practices for nonpoint sources are achieved. Furthermore, water quality may not be lowered to less than the level necessary to fully protect the "fishable/swimmable" uses and other existing uses.

Tier 3 – Protects the quality of outstanding national resources, such as waters of national and state parks, wildlife refuges and waters of exceptional recreational or ecological significance. There may be no new or increased discharges to these waters and no new or increased discharges to tributaries of these waters that would result in lower water quality (with the exception of some limited activities that result in temporary and short-term changes in water quality).

Specific Criteria:

Biochemical Oxygen Demand (BOD)

Dissolved oxygen (DO) is the water quality standard that is exceeded in the St. Francis River. In this case the DO has been found to be too low (i.e., below the required minimum of 5 mg/L). DO is not a "pollutant" and so cannot be allocated in a TMDL. As a result, we use Biochemical Oxygen Demand (BOD) as the parameter to determine the impact that wastewater will have on DO levels in a receiving stream. There is no numeric criterion in the Missouri Water Quality Standards (WQS) for BOD. Since DO cannot be allocated, but does have a numeric criterion, DO is linked to BOD. BOD is a pollutant that is measurable and may be allocated in a TMDL.

BOD is composed of carbonaceous oxygen demand (CBOD) and nitrogenous oxygen demand (NBOD). NBOD is estimated directly from Total Kjeldahl Nitrogen (TKN), which is ammonia nitrogen (NH_3-N) plus organic nitrogen. The numeric link between DO and BOD is generated by the water quality model QUAL2E, which is supported by U. S. Environmental Protection Agency (EPA). The QUAL2E model calculates BOD by using 5-day CBOD ($CBOD_5$), organic nitrogen, and ammonia nitrogen data from actual sample analyses. The present state water quality standards for all Missouri streams except cold water fisheries call for a daily minimum of 5 milligrams per liter (mg/L or parts per million) dissolved oxygen[4] or the natural upstream concentration of dissolved oxygen as determined on a regional or watershed basis.[5] The data in Table 1 was used to look at the background level of DO in the St. Francis River.

Table 1: Dissolved Oxygen concentration in the St. Francis River, 0.25 mile above the confluence with the tributary

	Flow (cfs)	Early Morning DO (mg/L)	Early Afternoon DO (mg/L)	Daily Fluctuation
August 7-8, 1996	0	2.7, 2.0	4.0, 3.7	1.3, 1.7
July 23-24, 1997	0.55	3.7, 3.4	4.4, 4.5	0.7, 1.1
August 8-10, 2001	2.7	4.7, 5.4	6.6, 6.8	1.9, 1.4
July 22, 2004	0.01	2.0	3.7	1.7

The small daily fluctuation values in Table 1 indicate photosynthesis has only a small effect on dissolved oxygen levels in this portion of the river and thus algal respiration is not responsible for the low DO values observed in 1996 and 1997. The major source of oxygen demand is believed to be bacterial respiration of terrestrial organic matter in bottom sediments. This portion of the St. Francis has not been developed, nor are there crops and livestock being raised. It has a low gradient and flows through a heavily wooded area. The combination of terrestrial vegetation inputs to streams, warm water temperatures and lack of water movement through large pools can cause substantial loss of dissolved oxygen. A site visit in August 2005 verified these observations, finding very warm water temperatures, sluggish or no flow and low DO (3.3 mg/L). These facts lead the department to conclude that the low DO upriver of the effluent tributary is a natural condition. However, since no regional or watershed site specific criteria have been adopted by the state, **the dissolved oxygen criterion remains a minimum of 5.0 mg/L for the St. Francis River**.

Ammonia

The specific criteria found in Missouri's Water Quality Standards (WQS) at 10 CSR 20-7.031(4) apply to all classified waters. The specific criteria for ammonia are found in 10 CSR 20-7.031 Table B. Cool water fisheries have the same chronic ammonia criteria as warm water fisheries and these criteria appear in Table B under the heading "General Warm Water Fishery." These criteria are pH and water temperature dependent. Seasonal **ammonia criteria** from the standards at the typical seasonal pH and water temperature values (7.8 pH and 8^{o}C winter and 26^{o}C summer) **are 1.2 mg/L (summer) and 2.0 mg/L (winter).** Note that all values in 10 CSR 20-7.031 Table B are given as total ammonia while permit limits are expressed as "ammonia as N[itrogen]" (NH_3-N). To convert from total ammonia to NH_3-N, divide by 1.2.

Numeric Water Quality Targets:

The water quality targets for this TMDL are the water quality standards criteria stated in the two paragraphs just above.

[4] 10 CSR 20-7.031(4)(J)
[5] 10 CSR 20-7.031(4)(A)(3)

3. Calculation of Load Capacity

Load capacity (LC) is defined as the greatest amount of loading of a pollutant that a waterbody can receive without violating water quality standards. This load is then divided among the point source (waste load allocation) and nonpoint source (load allocation) contributions to the stream, with an allowance for an explicit margin of safety. If the margin of safety is implicit, no numeric allowance is necessary. This is expressed in the following manner:

$$LC = WLA + LA + MOS$$

Critical conditions are considered when the LC is calculated. Dissolved oxygen levels that threaten the integrity of aquatic communities generally occur during low flow periods, so these periods are considered the critical conditions. The critical conditions for ammonia are also low flow conditions, which are most likely to accompany exceedences of ammonia standards. Under low flow conditions there is less water available to dilute pollutant loads. The 7Q10 flow is the lowest average flow for seven consecutive days that have a recurrence interval of once in 10 years. This represents the worse case flow scenario reasonably expected to occur. Allocations developed under 7Q10 conditions are believed to be protective during other seasons and expected flow scenarios, so they were chosen as the critical conditions. The 7Q10 flow for the St. Francis River is 0.1 cubic feet per second (cfs)[6].

Using the QUAL2E model, ammonia nitrogen (NH_3-N) and 5-day carbonaceous oxygen demand ($CBOD_5$) criteria and loads were developed for summer and winter periods. Model inputs that vary by season (climatology, headwater characteristics) were adjusted accordingly. The model contains six stream reaches, two of which represent the tributary. The reaches are subdivided into sub-reaches, or computational units, of 0.2 mile each. After calibration and validation, numerous simulations were modeled with varying point source loads of $CBOD_5$ and NH_3-N. The modeled maximum allowable loads (the loading capacity) are those loads that allow maintenance of in-stream WQS where the effluent meets classified water, or where the tributary joins the St. Francis.

Expressed as pounds per day (lbs/day), the Load Capacity (LC) is dependent on the WWTP discharge because nonpoint source contributions from the tributary upstream of the WWTP are considered to be zero (see Section 4). The LC for the river was calculated using the concentrations from the model results in the formula below. The 2.4 MGD design flow translates to 3.72 cubic feet per second (cfs). The figure 5.395 is the constant used to convert cfs times milligrams per liter (mg/L) to lbs/day.

Load Capacity = (design flow in cfs)(calculated concentration in mg/L)(5.395 conversion factor)

Summer: $LC_{NH3\text{-}N}$ = (3.72 cfs)(**2.0 mg/L**)(5.395) = **40.1 lbs/day**

Winter: $LC_{NH3\text{-}N}$ = (3.72 cfs)(**2.5 mg/L**)(5.395) = **50.2 lbs/day**

[6] Water Resources Report Number 32, USGS 1976

To calculate the load capacity for BOD_5, the nonpoint source load (or LA) must be added in (See Section 4.):

LC_{BOD5} = (3.72 cfs)(**10 mg/L**)(5.395) + 1.1 lbs./day = 200.7 + 1.1 = **201.8 lbs/day**

4. Load Allocation (Nonpoint Source Load)

Load Allocation (LA) includes all existing and future nonpoint sources and natural background contributions (40 CFR § 130.2(g)). The existing nonpoint source $CBOD_5$ concentrations in the tributary above the WWTP were as high as 6 mg/L in 2001 but were only 2 mg/L in the St. Francis River above the tributary. This may suggest a potential contribution from urban runoff. Likewise, NH_3-N concentrations in the same period were as high as 0.12 mg/L in the tributary and non-detect in the St. Francis River.

Because the critical flow conditions **in the tributary** above the WWTP are zero flow, no load would be contributed and **the LA is assigned as zero pounds per day**. However, the potential for urban runoff into the tributary should continue to be evaluated. If any problems are found based on future monitoring, they will be addressed in the next phase of this TMDL.

As already stated, the critical flow conditions in the St. Francis River are 0.1 cfs, so a LA can be calculated. In actuality, at summer low flows there is no flow in the river starting about 0.25 mile upstream of the confluence with the tributary (at the Rt. 67 bridge). The 2.0 mg/L $CBOD_5$ in the LA calculation below is the result of samples taken in the St. Francis River just upstream of the Farmington West WWTP effluent tributary in 2001. No NH_3-N was detected. The flow used is the same for both summer and winter to represent the worse case flow scenario. Thus the **nonpoint source loads (LAs) for the St. Francis** are calculated as follows:

Load Allocation = (stream flow in cfs)(instream pollutant concentration in mg/L)(5.395)

Summer and winter:
$LA_{NH3\text{-}N}$: (0.1 cfs)(0.0 mg/L)(5.395) = **0.0 pounds/day**
LA_{CBOD5}: (0.1 cfs)(2 mg/L)(5.395) = **1.1 pounds/day**

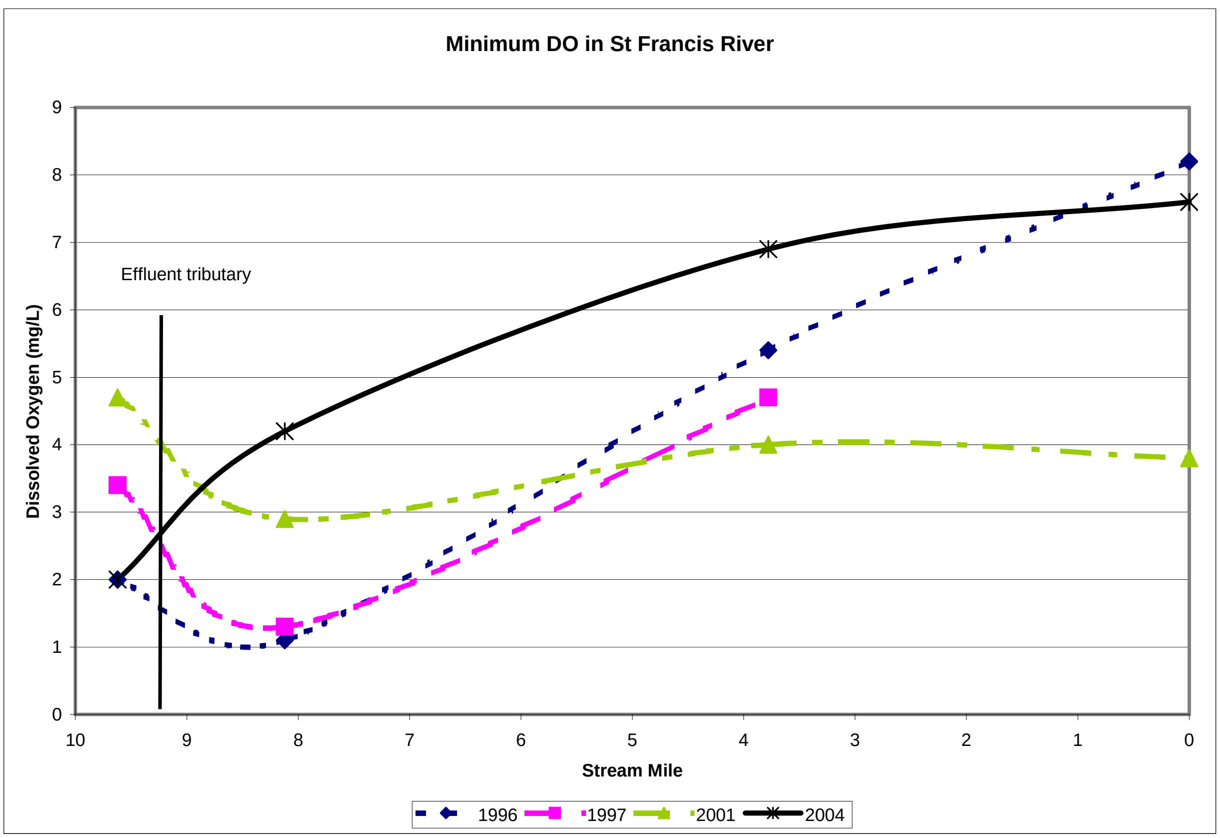
5. Waste Load Allocation (Point Source Loads)

The Waste Load Allocation (WLA) is the portion of a receiving water's load capacity that is allocated to its existing or future point sources of pollution. Aside from Farmington West WWTP, the Farmington Manor nursing home has a small lagoon that discharges to the St. Francis River about 0.5 miles upstream of the impaired segment. The impaired segment's upstream end begins where the Farmington West WWTP tributary enters the river. Water quality data taken upstream of the tributary in the St. Francis River showed very low levels of nutrients and non-detectable instream BOD, suggesting that the lagoon was either not discharging or the discharge was so small it was not having a discernable impact on instream water quality. In August 1999, this small lagoon was discharging less than 0.01 cfs into a large pool of the St. Francis River. The river at this point and time had no flow between the nursing home discharge and the upstream end of the impaired segment. During design conditions (0.1 cfs of flow in the St. Francis River) there would be an extremely long residence time (estimated at 3-4 days) for the Farmington Manor discharge in that upstream 0.5-mile segment of the river. It is expected that the very small $CBOD_5$ and NH_3-N loads from the Farmington Manor nursing home would be completely exhausted prior to entering the impaired segment of the river. This expectation is supported by data collected in 1992, 1996, 1997 and 1999. $CBOD_5$ and NH_3-N levels were consistently low in the St. Francis River immediately upstream of the Farmington West WWTP tributary. The impact of this small upstream source is, therefore, included in the background upstream nonpoint source loadings.

Due to the reasons listed above, it is believed that discharge from the Farmington West WWTP was the most significant cause for the impairments. A review of permit monitoring data collected prior to the upgrade, between 2001 and 1998, showed NH_3-N values as high as 9.2 mg/L in the summer and 13.9 mg/L in the winter. Likewise $CBOD_5$ values were as high as 63 mg/L in the summer and 54 mg/L in the winter. The expired permit for this facility limited NH_3-N to 2.5 mg/L in summer and 3.0 mg/L in winter and $CBOD_5$ to 10 mg/L in the summer and 25 mg/L in the winter. These limits were both the daily maximum and the monthly average.

As was stated in Section 1 under Defining the Problem, more data were collected in the summer of 2004 during two 24-hour water quality surveys (post-construction monitoring) of the St. Francis River. Water quality data are in Appendix C.2. Figure 1 below indicates that, while improvement is evident, compliance with water quality criteria, specifically the minimum of 5 mg/L for dissolved oxygen, has yet to be fully achieved.

Figure 1: Observed Early Morning DO in the St. Francis River



Plant Performance:
The upgrades at the plant have resulted in significantly improved performance. This is evident in the discharge monitoring reports (DMRs) for $CBOD_5$ and ammonia nitrogen (Figures 2 and 3). See also the data tables in Appendix D. However, this performance, as shown in Figure 1, is not a guarantee of protection of water quality. One uncertainty factor is the dissolved oxygen content upstream of the effluent tributary and thus beyond the control of the facility. See the instream monitoring data in Appendix E.

The facility is still a potential contributor to stream degradation, and the current effluent limits have been re-examined to reduce the uncertainty. For $CBOD_5$, if the plant discharges at the full design flow of 2.4 MGD, with the maximum concentration allowed in the present permit, the load will be within the limits of the WLA for both summer and winter. For NH_3-N, under the same scenario, the WLA would be exceeded by 105 percent in the summer, and 29 percent in the winter.

Figure 2. Maximum daily $CBOD_5$ at Farmington West WWTP

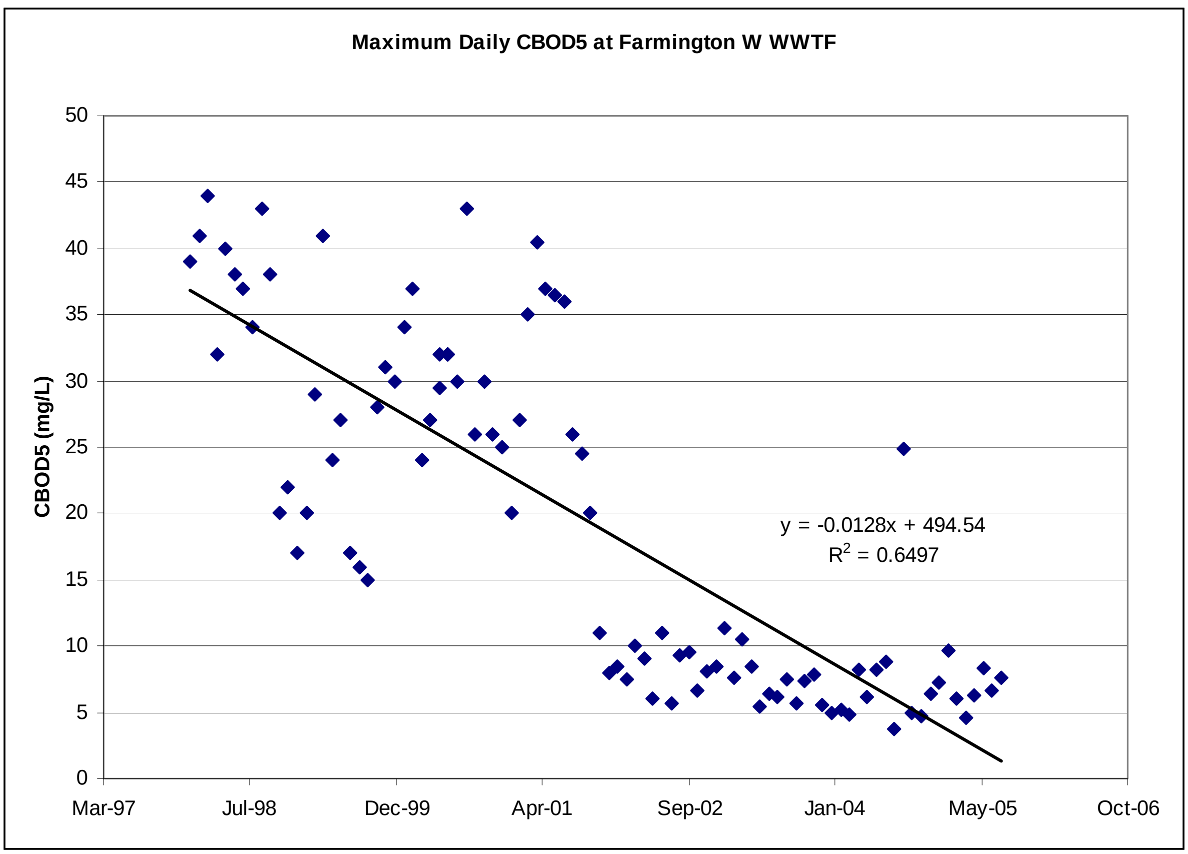
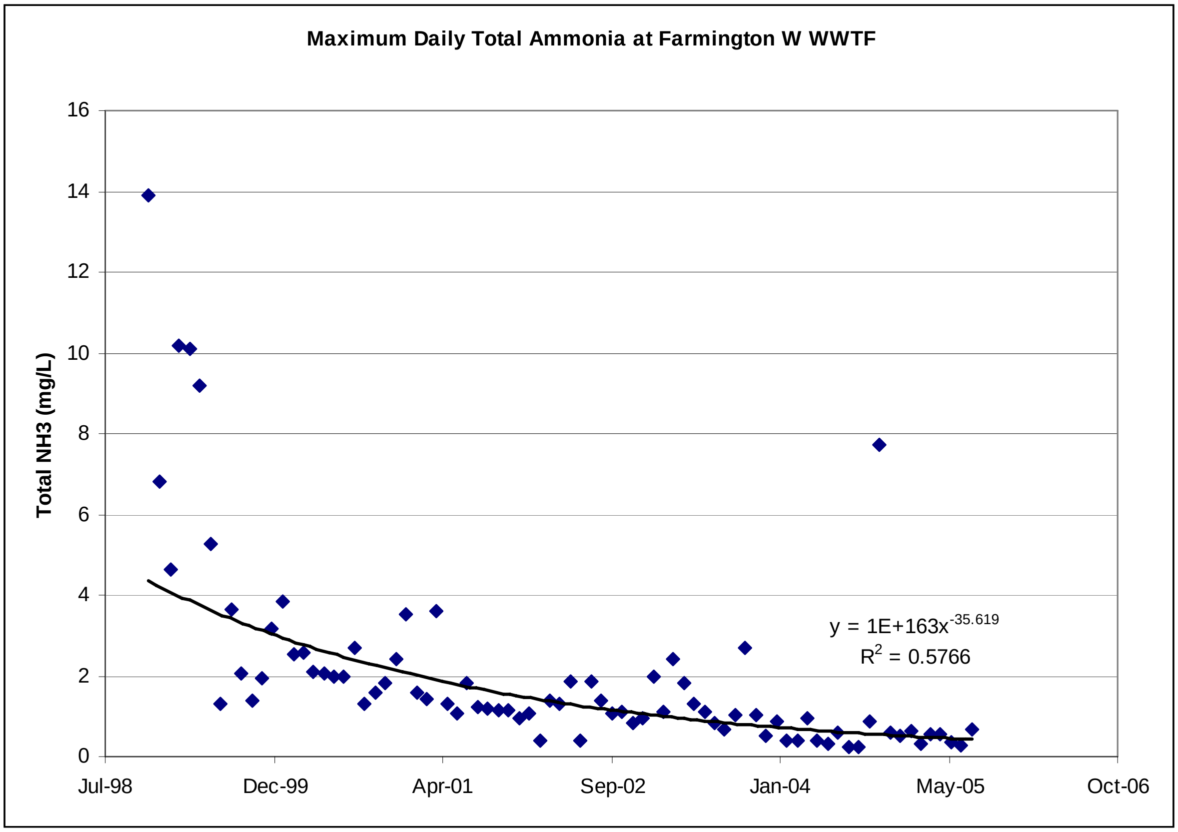


Figure 3. Maximum daily total ammonia at Farmington West WWTP



The QUAL2E model was run again (using the 2004 data), with the same settings as previously, to re-estimate what limits will protect water quality in the St Francis River. While the river is listed for BOD and ammonia, data from stream surveys indicate a significant load of total nitrogen and total phosphorus in the effluent from the WWTP. These nutrient issues are being addressed through voluntary minimization of nutrient loading to the WWTP, as discussed in the Concluding Remarks below. Using the concentrations from the QUAL2E model, the wasteload allocations were calculated as follows and are summarized in Table 2:

WLA = (design flow in cfs)(concentration in mg/L)(5.395 conversion factor)

Summer: $WLA_{NH3\text{-}N}$ = (3.72 cfs)(**2.0 mg/L**)(5.395) = **40.1 lbs/day**

Winter: $WLA_{NH3\text{-}N}$ = (3.72 cfs)(**2.5 mg/L**)(5.395) = **50.2 lbs/day**

To calculate the wasteload allocation for BOD_5, seasonality does not have to be considered:

WLA = (3.72 cfs)(**10 mg/L**)(5.395) = **200.7 lbs/day**

Table 2: TMDL Waste Load Allocations for St. Francis River near Farmington

Summer	BOD_5	NH_3-N
Pounds per day	201	40
WLA mg/L	10	2
Winter		
Pounds per day	201	50
WLA mg/L	10	2.5

Concluding Remarks:
The department has discussed the nutrient issue with Farmington West WWTP management. It appears that the most likely source of nutrients is laundry detergent in the waste streams of several local industries. These industries will be approached about a voluntary phosphorous minimization program before the city calculates "local limits" that would require onsite pretreatment. Although planned for the future, criteria for nutrients do not currently exist in Missouri's WQS and therefore there are no nutrient criteria that are applicable to the St. Francis River. When nutrient criteria are promulgated, appropriate limits for this facility will need to be calculated.

6. Margin of Safety

A Margin of Safety (MOS) is required in the TMDL calculation to account for uncertainties in scientific and technical understanding of water quality in natural systems. The MOS is intended to account for such uncertainties in a conservative manner. Based on EPA guidance, the MOS can be achieved through one of two approaches:

(1) Explicit - Reserve a portion of the loading capacity as a separate term in the TMDL.
(2) Implicit - Incorporate the MOS as part of the critical conditions for the waste load allocation and the load allocation calculations by making conservative assumptions in the analysis.

The MOS is implicit in this TMDL and is included in conservative model assumptions and calculations. One example is that QUAL2E simulations were run using an effluent DO of 5 mg/L, while, in 2004, the plant consistently produced a discharge containing more than 6 m/L DO (Table 3). Effluent DO concentration over <u>all</u> the years was above 5.5 mg/L, except once in 2001 when it measured 4.9 mg/L in the afternoon (14:40). All early morning DO measurements were $\geq$5.5 mg/L. This is a conservative approach that is used as part of the margin of safety.

Table 3: Early morning effluent DO concentration

Year	Month	Day	Time	Flow	C	DO
1996	8	8	750		26	5.5
1996	8	7	650		26	5.7
1997	7	23	615		27	5.6
1997	7	24	620		27	6.1
2001	8	10	605	1.5	26	5.7
2001	8	9	605		26	6
2004	7	21	625	1.7	26	6.4
2004	7	22	612		27	6.5

Note: C = temperature in degrees Celsius

7. Seasonal Variation

Toxicity of ammonia species (NH_3 & NH_4^+) to fishes and invertebrates is well documented[7]. High pH and temperature increase the proportion of the more toxic NH_3 form and thus ammonia toxicity limits are seasonal in nature. Both summer and winter TMDL allocations for ammonia were developed.

8. Monitoring Plan for TMDLs Developed under Phased Approach

Using the reopener clause, instream-monitoring sites were added to Farmington West's permit in January 2003. Since then, ambient water quality data has been gathered monthly by the facility in the St. Francois River both upstream and downstream of the tributary. The parameters that are being collected at these points are DO, BOD, pH, temperature, NH_3-N, nitrate plus nitrite as nitrogen, total Kjeldahl nitrogen, and total phosphorus. These data may be found in Appendix E. The next monitoring scheduled by the department will be low flow studies in 2007 and 2008. As with all of Missouri's TMDLs, if continuing monitoring reveals that water quality standards are not being met, the TMDL will be reopened and re-evaluated accordingly. This TMDL will be incorporated into Missouri's Water Quality Management Plan.

9. Implementation Plans

This TMDL will be implemented through permit action. Farmington West WWTP completed an upgrade to their facility November 22, 2001. Permit limits from modeling performed in 1999 were written into the State Operating Permit (#MO-0040312) and went into effect March 1, 2002. These were $CBOD_5$ 10/10 mg/L (daily maximum/monthly average) in the summer and 25/25 mg/L in the winter. For ammonia, the limits were 2.5/2.5 mg/L in the summer and 3.0/3.0 mg/L for the winter. The current permit for the facility expired in May 2005. Based on the WLAs detailed in this TMDL, new permit limits (Water Quality Based Effluent Limits) for the WWTP will be calculated using the methods and procedures outlined in the EPA Technical Support Document (EPA/505/2-90-001). As discussed above (see Concluding Remarks), nutrient limits will not be included in the permit at this time. Instead, they will be addressed through voluntary minimization of nutrients by the responsible industries or through pretreatment limits. If future monitoring shows that water quality standards are not being met, the permit can be reopened to incorporate new or modified effluent limitation or other conditions necessary to ensure compliance with Missouri's Water Quality Standards. If other sources are discovered, this TMDL will be revisited.

10. Reasonable Assurances

The department has the authority to write and enforce State Operating Permits. Inclusion of effluent limits (determined from the allocations established by the modeling) into a state permit, and quarterly monitoring of the effluent reported to the department, should provide reasonable assurance that instream water quality standards will be met.

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[7] *Ambient Water Quality Criteria for Ammonia-1984*, EPA 440/5-85-001, and *1999 Update of Ambient Water Quality Criteria for Ammonia*, EPA-822-R-99-014

11. Public Participation

This water quality limited segment of the St. Francis River is included on the approved 2002 303(d) list for Missouri. After the Missouri Department of Natural Resources develops a TMDL, it is sent to EPA for examination and then the edited draft is placed on public notice. The public notice period for the draft St. Francis River TMDL was from Nov. 18 to Dec. 18 2005. Groups that received the public notice announcement included the Missouri Clean Water Commission, Farmington West WWTP, the Water Quality Coordinating Committee, the St. Francois County Soil and Water Conservation District, Stream Team volunteers in the watershed (31), the appropriate legislators (3) and others that routinely receive the public notice of Missouri State Operating Permits (also called NPDES permits). One comment was received; however, it did not require any adjustments to the TMDL. This letter and the department's response have been placed in the St. Francis River file, as detailed below.

12. Administrative Record and Supporting Documentation

An administrative record on the St. Francis River TMDL has been assembled and is being kept on file with the Missouri Department of Natural Resources. It includes the following:

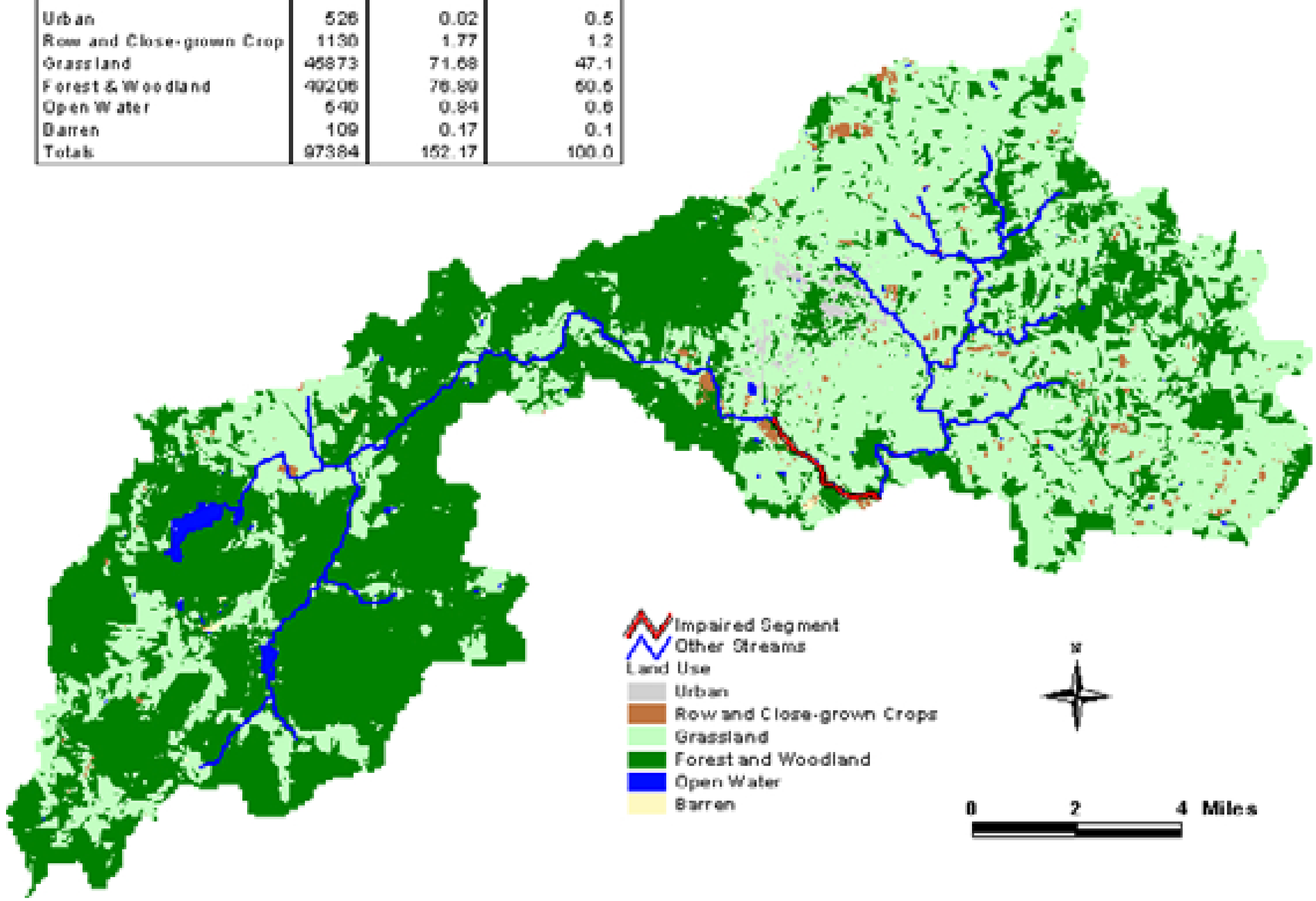
- Farmington West WWTP State Operating Permit MO-0023019
- Early morning water quality study July 8, 1992, conducted by the department's Water Pollution Control Program (now Water Protection Program)
- Environmental Services Program, 48-hour water quality studies of August 6-8, 1996, and July 22-24, 1997
- Water Pollution Control Program data from August 8-10, 2001 (now Water Protection Program)
- Water Protection Program data from July 21-22, 2004
- QUAL2E input and output files
- Information Sheet, public notice announcement, comment letter and response

13. Appendices

Appendix A – Land Use in the Upper St. Francis River Watershed – Map and Distribution List
Appendix B – Map of the Upper St. Francis River Watershed
Appendix C – Topographic Map of the Impaired Segment with Sampling Sites and Corresponding Water Quality Data
Appendix D – Discharge Monitoring (DMR) Data from the Farmington West WWTP
Appendix E – Instream Monitoring Data collected by the WWTP from the St. Francis River
Appendix F – Construction permit (2001)

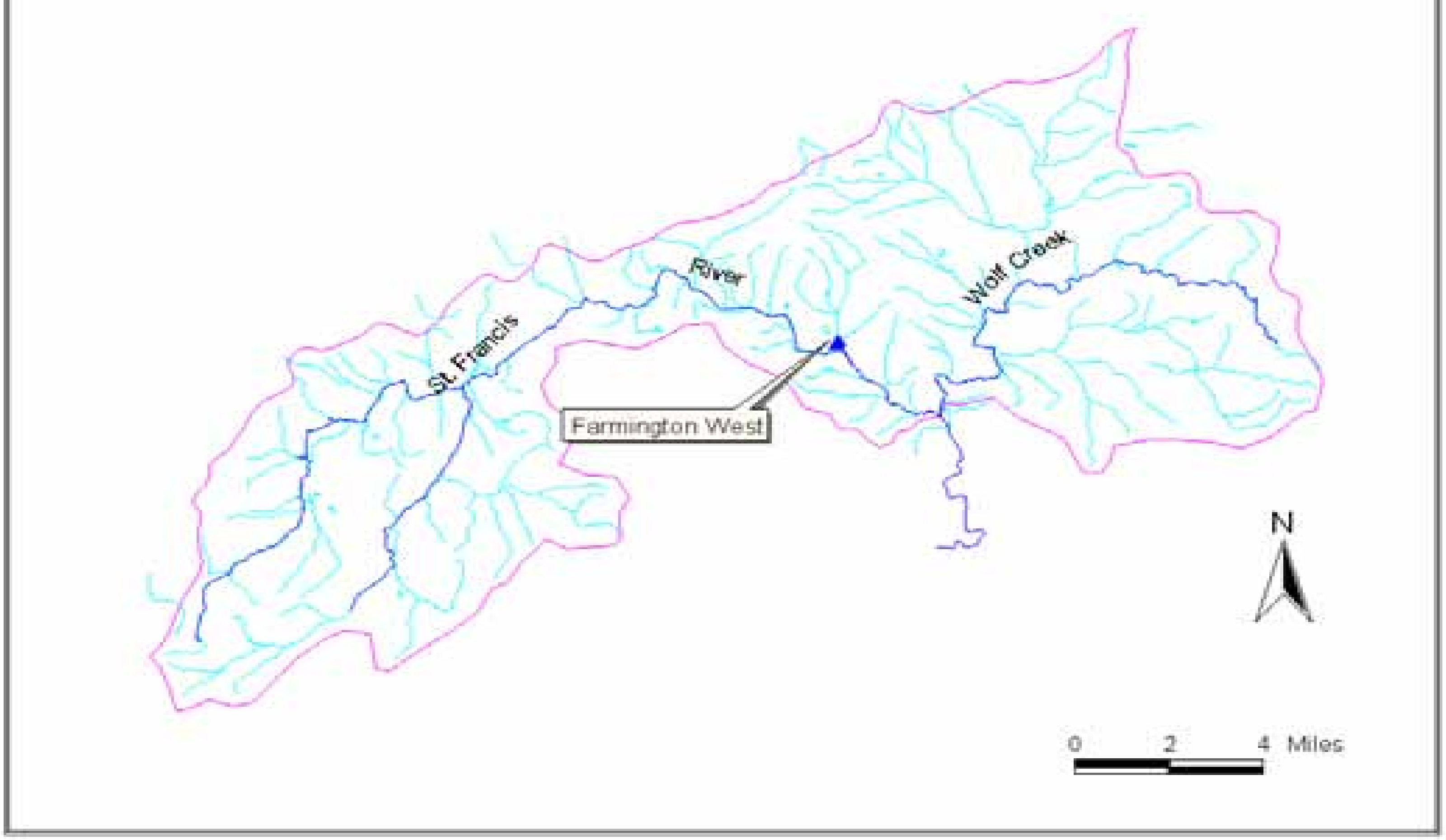
Appendix A: Land Use Map of the Upper St. Francis River upstream from Wolf Creek

Land Use Type	Acres	Sq. Miles	Percentage
Urban	526	0.02	0.5
Row and Close-grown Crop	1130	1.77	1.2
Grassland	45873	71.68	47.1
Forest & Woodland	49206	76.89	50.5
Open Water	540	0.84	0.6
Barren	109	0.17	0.1
Totals	97384	152.17	100.0



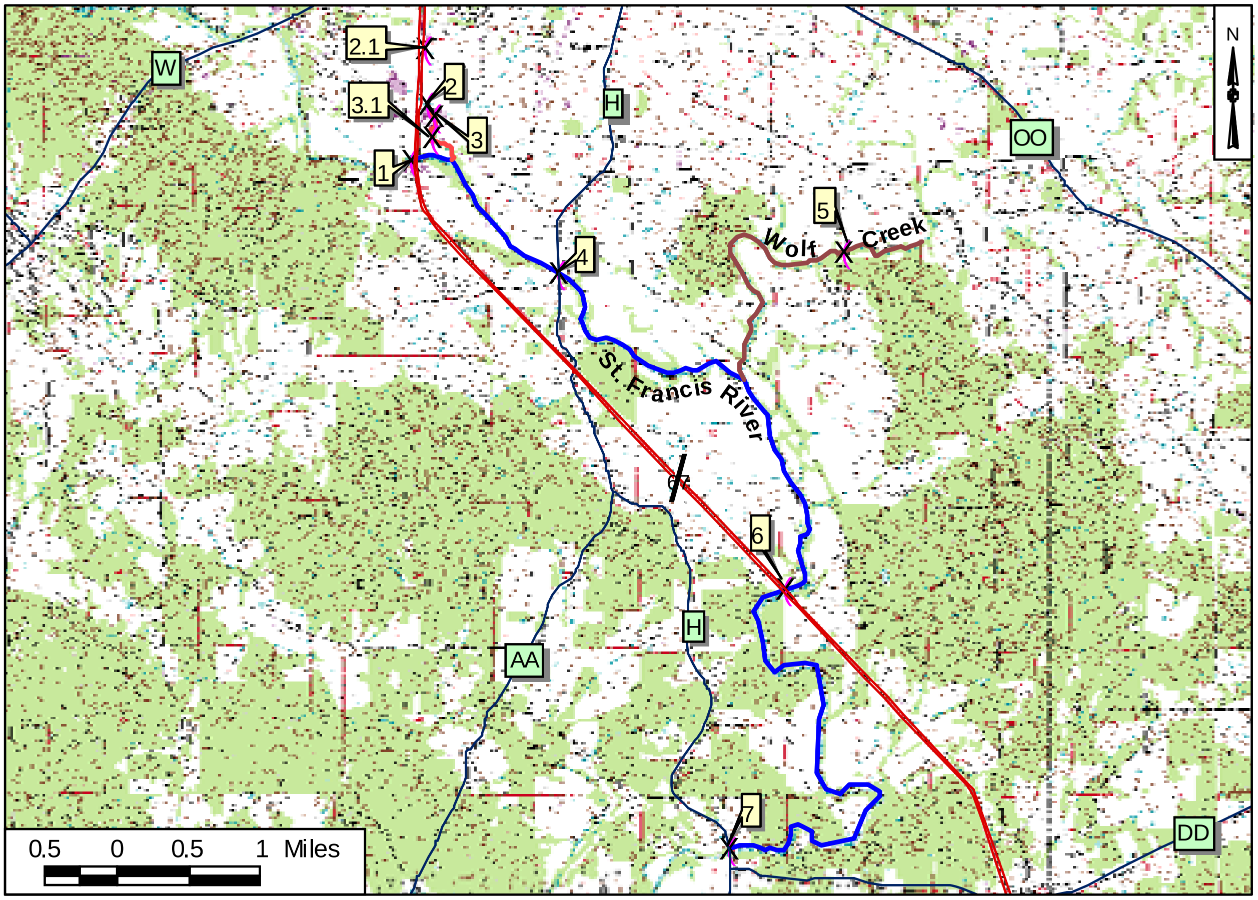
Appendix B

Appendix B: Upper St. Francis River Watershed.



Appendix C
Topographic Map and Water Quality Data

Appendix C.1 Topographic map of Impaired Section of the St. Francis River with Sampling Sites



MDNR Monitoring Sites
1 – St. Francis River 0.25 mile above effluent tributary
2 – Tributary to St. Francis River 50 yards above outfall
2.1 – Tributary to St. Francis River 0.5 miles above outfall
3 – Farmington West WWTP outfall
3.1 – Tributary to St. Francis River 50 yards below outfall
4 – St. Francis River at Gruner Ford Conservation Area
5 – Wolf Creek 4 miles below Farmington East WWTP
6 – St. Francis River 1.75 miles below Wolf Creek
7 – St. Francis River at Highway H

Appendix C.2 Data from water quality studies 1996, 1997, 2001 and 2004

Site #	1996	Time (24 hr)	Temp (^oC)	DO (mg/L)	$CBOD_5$ (mg/L)	TKN (mg/L)	NH_3N (mg/L)	$NO_2 + NO_3$ (mg/L)
1	8/7/1996	630	25	2.7	non-detect		non-detect	non-detect
2.1	8/7/1996	605	23	4.2	non-detect		non-detect	0.46
3	8/7/1996	650	26	5.7				
4	8/7/1996	615	25	1.1	non-detect		0.26	2.82
6	8/7/1996	640	25	6.3	non-detect		non-detect	0.74
7	8/7/1996	706	27	8.6	non-detect		non-detect	0.07
1	8/7/1996	1240	28	4	3		non-detect	0.06
2.1	8/7/1996	1220	25	4.3	non-detect		non-detect	0.45
3	8/7/1996	1145			9		5.41	1.93
3	8/7/1996	1205	27	7.2				
4	8/7/1996	1225	27	6.3	non-detect		0.55	2.72
6	8/7/1996	1243	26	8.4	non-detect		non-detect	0.68
7	8/7/1996	1302	28	10.9	3		non-detect	non-detect
1	8/8/1996	720	25	2	non-detect		0.11	non-detect
2.1	8/8/1996	710	24	4.8	non-detect		non-detect	0.21
3	8/8/1996	750	26	5.5				
4	8/8/1996	650	25	1.2	non-detect		0.57	2.72
6	8/8/1996	630	25	5.4	non-detect		0.05	0.73
7	8/8/1996	605	26	8.2	non-detect		non-detect	0.1
1	8/8/1996	1335	28	3.7	non-detect		0.12	0.07
2.1	8/8/1996	1315	26	10.9	non-detect		non-detect	0.53
3	8/8/1996	1125			7		6.13	3.5
3	8/8/1996	1135	27	6.6				
4	8/8/1996	1255	27	7.5	1.999		0.68	2.56
6	8/8/1996	1235	27	9.2	non-detect		0.06	0.68
7	8/8/1996	1210	28	9.2	non-detect		non-detect	0.06
Site #	**1997**	**Time (24 hr)**	**Temp (^oC)**	**DO (mg/L)**	**$CBOD_5$ (mg/L)**	**TKN (mg/L)**	**NH_3N (mg/L)**	**$NO_2 + NO_3$ (mg/L)**
1	7/23/1997	600	27	3.7	1.999		0.07	0.08
2.1	7/23/1997	540	24	3.3	1.999		0.02	0.52
3	7/23/1997	615	27	5.6				
4	7/23/1997	600	25	1.4	non-detect		4.23	0.66
6	7/23/1997	545	26	4.9	non-detect		0.07	0.94
1	7/23/1997	1310	29	4.4	non-detect		0.06	0.08
2.1	7/23/1997	1255	26	5.6	1.999		0.02	0.35
3	7/23/1997	1230	25	5.6	9		8.87	0.86
4	7/23/1997	1230	27	5.2	non-detect		3.17	0.94
6	7/23/1997	1215	27	7.2	non-detect		0.05	0.88
1	7/24/1997	600	26	3.4	non-detect		0.07	0.07
2.1	7/24/1997	540	23	4.6	non-detect		0.01	0.34
3	7/24/1997	620	27	6.1				
4	7/24/1997	558	25	1.3	non-detect		1.64	1.16

6	7/24/1997	540	26	4.7	non-detect		0.06	0.92
1	7/24/1997	1230	28	4.5	non-detect		0.05	0.07
2.1	7/24/1997	1245	25	7.5	non-detect		0.06	0.36
3	7/24/1997	1210	25	5.9	16		6.24	0.77
4	7/24/1997	1213	26	5.3	1.999		1.94	1.01
6	7/24/1997	1155	27	7.1	non-detect		0.07	0.93
Site #	**2001**	**Time (24 hr)**	**Temp (^oC)**	**DO (mg/L)**	**$CBOD_5$ (mg/L)**	**TKN (mg/L)**	**NH_3N (mg/L)**	**NO_2 + NO_3 (mg/L)**
1	8/8/2001	1455	28	6.6	2	1.44	non-detect	non-detect
2	8/8/2001	1445	28	9.4	6	1.21	0.05	0.26
3	8/8/2001	1440	27	4.9	non-detect	non-detect	non-detect	16.1
3.1	8/8/2001	1430	28	4.7	2	0.52	0.44	12.1
4	8/8/2001	1505	28	5.8	non-detect	1.43	0.11	2.79
5	8/8/2001	1610	29	5.8	non-detect	1.16	0.13	6.8
6	8/8/2001	1520	28	6	non-detect	1.17	0.1	1.3
7	8/8/2001	1540	28	5.9	3	0.76	non-detect	0.67
1	8/9/2001	620	26	4.7	non-detect	0.66	non-detect	non-detect
2	8/9/2001	610	24	4.1	4	1.17	0.12	0.36
3	8/9/2001	605	26	6	non-detect	0.099	non-detect	15.8
3.1	8/9/2001	600	26	2.2	non-detect	1.13	0.54	10
4	8/9/2001	630	26	3.3	non-detect	0.99	0.12	2.89
5	8/9/2001	720	25	4.2	non-detect	0.79	0.09	7.6
6	8/9/2001	640	26	4	non-detect	0.78	0.15	1.19
7	8/9/2001	655	27	4.3	non-detect	0.79	0.09	0.73
1	8/9/2001	1430	30	6.8	non-detect	0.63	non-detect	non-detect
2	8/9/2001	1415	30	7.2	4	1.5	0.07	0.3
3	8/9/2001	1410	28	5.7	non-detect	1.05	0.25	15.9
3.1	8/9/2001	1405	29	4.9	non-detect	0.55	0.29	12.7
4	8/9/2001	1440	29	6.6	non-detect	1.35	0.07	4.12
5	8/9/2001	1530	27	6.2	non-detect	0.099	0.16	8.21
6	8/9/2001	1450	29	6.6	non-detect	0.89	0.17	1.29
7	8/9/2001	1505	29	5.4	non-detect	0.68	0.05	0.75
1	8/10/2001	620	26	5.4	non-detect	0.64	non-detect	non-detect
2	8/10/2001	610	24	4.3	4	0.71	0.1	0.29
3	8/10/2001	605	26	5.7	non-detect	1.42	non-detect	14
3.1	8/10/2001	600	26	2.7	non-detect	2.23	0.47	12.4
4	8/10/2001	630	25	2.9	non-detect	0.87	0.08	3.84
5	8/10/2001	715	25	4.5	non-detect	0.71	0.17	7.91
6	8/10/2001	640	26	4.2	non-detect	0.85	0.17	1.47
7	8/10/2001	650	27	3.8	non-detect	0.82	0.1	0.72
Site #	**2004**	**Time (24 hr)**	**Temp (^oC)**	**DO (mg/L)**	**$CBOD_5$ (mg/L)**	**TKN (mg/L)**	**NH_3N (mg/L)**	**NO_2 + NO_3 (mg/L)**
3	7/21/04	625	26	6.4				
3	7/21/04	1350	28	7.1				
1	7/22/04	630	25.5	2	non-detect	0.63	0.07	0.03

2	7/22/04	550	25	5	non-detect	0.42	non-detect	0.19
3	7/22/04	612	27	6.5				
3.1	7/22/04	600	26.5	3.6	non-detect	0.82	0.06	11.5
4	7/22/04	555	26	4.2	non-detect	1.26	non-detect	11.4
5	7/22/04	650	25	5.2	non-detect	1.01	non-detect	6.55
6	7/22/04	620	26	6.9	non-detect	1.01	non-detect	6.84
7	7/22/04	650	27.5	7.6	non-detect	0.77	non-detect	1.78
1	7/22/04	1300	28	3.7	non-detect	0.63	0.05	0.03
2	7/22/04	1235	30	8.2	non-detect	0.41	non-detect	0.17
3	7/22/04	1100			3.05	0.94	0.11	16.3
3	7/22/04	1223	28	7.2				
3.1	7/22/04	12:45	29	8.2	non-detect	1.11	non-detect	16.9
4	7/22/04	1310	28	8.4	non-detect	1.3	non-detect	11
5	7/22/04	1325	27	6.4	2.12	1.01	non-detect	6.41
6	7/22/04	1250	28	9.5	2.34	1.17	non-detect	6.85
7	7/22/04	1230	30	9.9	2.02	0.82	non-detect	1.76

Temp=Temperature in degrees Celsius; D.O.=Dissolved Oxygen; $CBOD_5$=Chemical Biochemical Oxygen Demand; TKN=Total Kjeldahl Nitrogen; NH_3N=Ammonia as Nitrogen; NO_2+NO_3= Nitrite plus Nitrate as Nitrogen

Appendix D
Discharge Monitoring Reports (data) from Farmington West WWTP from facility update through August 2005

Table D-1. CBOD results from DMRs from Farmington West WWTF

Month/ Year	Max daily conc CBOD (mg/L)	Month/ Year	Max daily conc CBOD (mg/L)	Month/ Year	Max daily conc CBOD (mg/L)	Month/ Year	Max daily conc CBOD (mg/L)
---	---	Jan-03	11.3	Jan-04	4.9	Jan-05	7.3
---	---	Feb-03	7.6	Feb-04	5.2	Feb-05	9.7
Mar-02	10	Mar-03	10.5	Mar-04	4.8	Mar-05	6
Apr-02	9	Apr-03	8.5	Apr-04	8.2	Apr-05	4.6
May-02	6	May-03	5.4	May-04	6.1	May-05	6.3
Jun-02	11	Jun-03	6.4	Jun-04	8.2	Jun-05	8.3
Jul-02	5.7	Jul-03	6.2	Jul-04	8.8	Jul-05	6.7
Aug-02	9.3	Aug-03	7.5	Aug-04	3.7	Aug-05	7.6
Sep-02	9.6	Sep-03	5.7	Sep-04	24.9	---	---
Oct-02	6.7	Oct-03	7.4	Oct-04	5	---	---
Nov-02	8.1	Nov-03	7.8	Nov-04	4.7	---	---
Dec-02	8.4	Dec-03	5.6	Dec-04	6.4	---	---

Table D-2. NH_3-N results from DMRs from Farmington West WWTF

Month/ Year	Max daily conc NH3-N (mg/L)	Month/ Year	Max daily conc NH3-N (mg/L)	Month/ Year	Max daily conc NH3-N (mg/L)	Month/ Year	Max daily conc NH3-N (mg/L)
---	---	Jan-03	1.97	Jan-04	0.88	Jan-05	0.51
---	---	Feb-03	1.1	Feb-04	0.41	Feb-05	0.64
Mar-02	1.37	Mar-03	2.4	Mar-04	0.41	Mar-05	0.33
Apr-02	1.31	Apr-03	1.83	Apr-04	0.97	Apr-05	0.54
May-02	1.88	May-03	1.31	May-04	0.4	May-05	0.55
Jun-02	0.39	Jun-03	1.11	Jun-04	0.31	Jun-05	0.37
Jul-02	1.86	Jul-03	0.84	Jul-04	0.59	Jul-05	0.27
Aug-02	1.37	Aug-03	0.66	Aug-04	0.23	Aug-05	0.69
Sep-02	1.07	Sep-03	1.03	Sep-04	0.25	---	---
Oct-02	1.11	Oct-03	2.7	Oct-04	0.86	---	---
Nov-02	0.83	Nov-03	1.04	Nov-04	7.71	---	---
Dec-02	0.94	Dec-03	0.51	Dec-04	0.61	---	---

Appendix E
Instream Monitoring Data

Farmington West WWTP personnel collected these data at the following sites, as identified in their state operating permit:

Site S1-5 is in the St Francis River, 300 feet upstream its confluence with the receiving tributary. Site S1-6 is in the St. Francis River, 300 feet downstream of the tributary.

Instream DMR Data for Farmington West Wastewater Treatment Plant

Date	Analyte	S1 - 5	S1 - 6
5/25/2005	NH3-N	0.13	0.1
	DO	1.9	2.1
	Temp-C	21	21
	pH	7.31	7.37
	BOD	3.4	3.6
	TKN	1.39	1.51
	NO3+NO2-N	<0.02	9.04
	TP	0.023	1.95
4/19/2005	NH3-N	0.1	0.07
	DO	3.1	3.3
	Temp-C	20	20
	pH	7.22	7.39
	BOD	3.8	4
	TKN	1.39	1.61
	NO3+NO2-N	0.13	0.174
	TP	0.39	0.239
3/10/2005	NH3-N	0.06	0.05
	DO	4.1	4.4
	Temp-C	13	13
	pH	7.29	7.43
	BOD	4.3	4.4
	TKN	0.915	0.937
	NO3+NO2-N	0.065	0.475
	TP	<0.010	0.364
2/3/2005	NH3-N	0.08	0.05
	DO	4.7	4.8
	Temp-C	14	14
	pH	7.32	7.41
	BOD	3.1	3.3
	TKN	0.952	0.851
	NO3+NO2-N	0.172	0.439
	TP	<0.010	0.25
1/26/2005	NH3-N	0.1	0.08
	DO	5.2	5
	Temp-C	16	16
	pH	7.41	7.49
	BOD	2.8	3.3
	TKN	0.891	0.983
	NO3+NO2-N	0.365	0.439
	TP	0.023	0.236
12/9/2004	NH3-N	0.07	0.05
	DO	4.9	4.2
	Temp-C	18	18
	pH	7.37	7.46
	BOD	3.6	4.4
	TKN	1.33	1.46
	NO3+NO2-N	0.02	0.092
	TP	0.459	0.435
9/15/2004	NH3-N	0.14	0.11
	DO	5.9	5.5
	Temp-C	26	26
	pH	7.13	7.21
	BOD	4.8	5.1
	TKN	2.88	3.79
	NO3+NO2-N	0.026	2.92
	TP	0.214	14.3
8/26/2004	NH3-N	0.16	0.1
	DO	6	5.7
	Temp-C	27	27
	pH	7.18	7.21
	BOD	4.8	5.6
	TKN	1.41	1.37
	NO3+NO2-N	0.049	1.81
	TP	0.341	5.01
7/7/2004	NH3-N	0.13	0.07
	DO	6.9	6.3
	Temp-C	26	26
	pH	7.31	7.47
	BOD	3.6	4.3
	TKN	2.96	3.08
	NO3+NO2-N	0.059	0.801
	TP	0.02	3.04
6/24/2004	NH3-N	0.16	0.1
	DO	6.6	6.5
	Temp-C	24	24
	pH	7.48	7.59
	BOD	2.8	2.8
	TKN	1.65	2.21

Date	Analyte	S1 – 5	S1 - 6
	NO3+NO2-N	0.01	1.28
	TP	0.366	4.87
5/25/2004	NH3-N	0.1	0.07
	DO	6	6.4
	Temp-C	21	21
	pH	7.37	7.51
	BOD	1.6	1.6
	TKN	1.49	1.63
	NO3+NO2-N	0.049	0.322
	TP	0.085	1.1
4/23/2004	NH3-N	0.12	0.09
	DO	5.9	6.6
	Temp-C	19	19
	pH	7.5	7.43
	BOD	2.8	3.2
	TKN	2.99	2.56
	NO3+NO2-N	<0.010	0.921
	TP	0.063	1.49
3/19/2004	NH3-N	0.17	0.11
	DO	5.7	6.1
	Temp-C	17	17
	pH	7.44	7.37
	BOD	3.2	3.3
	TKN	2.38	2.59
	NO3+NO2-N	0.133	0.33
	TP	0.033	0.426
2/19/2004	NH3-N	0.15	0.13
	DO	5	6
	Temp-C	16	16
	pH	7.31	7.4
	BOD	3.1	3
	TKN	2.75	2.35
	NO3+NO2-N	0.013	0.204
	TP	0.133	0.257
1/14/2004	NH3-N	0.14	0.14
	DO	4.9	6.2
	Temp-C	10	10
	pH	7.27	7.39
	BOD	2.8	2.8
	TKN	2.68	1.8
	NO3+NO2-N	1.08	1.1
	TP	2.31	1.71
12/11/2003	NH3-N	0.15	0.16
	DO	4.6	6
	Temp-C	8	8
	pH	7.31	7.44
	BOD	3.2	4.6
	TKN	0.758	0.634
	NO3+NO2-N	0.03	0.112
	TP	0.11	0.183

Date	Analyte	S1 – 5	S1 – 6
11/19/2003	NH3-N	0.16	0.21
	DO	4.3	6.1
	Temp-C	10	12
	pH	7.23	7.36
	BOD	3.1	4.7
	TKN	1.91	1.17
	NO3+NO2-N	0.105	0.25
	TP	0.046	0.032
10/29/2003	NH3-N	0.23	0.34
	DO	3.6	0.57
	Temp-C	12	17
	pH	7.1	7.33
	BOD	3.1	3.9
	TKN	1.09	3.28
	NO3+NO2-N	0.053	6.34
	TP	0.177	11.6
9/1/2003	NH3-N	0.2	0.29
	DO	3.4	3.5
	Temp-C	17	17
	pH	7.13	7.41
	BOD	2.9	3.7
	TKN	0.833	1.08
	NO3+NO2-N	0.16	6.93
	TP	0.02	16.5
8/27/2005	NH3-N	0.025	0.32
	DO	2.8	3.5
	Temp-C	26	26
	pH	7.09	7.37
	BOD	2.8	4.2
	TKN	0.536	0.871
	NO3+NO2-N	0.19	7.68
	TP	0.043	20.6
7/23/2003	NH3-N	0.1	0.16
	DO	3.5	3.7
	Temp-C	23	23
	pH	7.04	7.31
	BOD	1.4	3.3
	TKN	1.02	1.38
	NO3+NO2-N	0.04	4.09
	TP	0.08	11.6
6/18/2003	NH3-N	0.19	0.53
	DO	1.3	1.6
	Temp-C	67	67
	pH	7.11	7.06
	BOD	3.3	3.8
	TKN	1.32	1.57
	NO3+NO2-N	0.03	0.736
	TP	0.098	0.457
5/14/2003	NH3-N	0.15	0.64
	DO	1.2	1.9

Date	Analyte	S1 - 5	S1 – 6
	Temp-C	64	64
	pH	7.04	7.01
	BOD	2.88	2.76
	TKN	0.121	0.808
	NO3+NO2-N	0.046	0.919
	TP	0.709	1.09
4/16/2003	NH3-N	0.14	0.15
	DO	1.3	1.6
	Temp-C	68	68
	pH	7.24	7.12
	BOD	2.64	2.64
	TKN	1.15	1.08
	NO3+NO2-N	0.154	0.801
	TP	0.207	0.214
3/12/2003	NH3-N	0.19	0.17
	DO	1.1	1.3
	Temp-C	62	62
	pH	7.04	7.51
	BOD	3.15	3.45
	TKN	1.33	2.56
	NO3+NO2-N	0.023	0.539
	TP	7.24	1.01

Temp-C=Temperature in degrees Celsius; D.O.=Dissolved Oxygen; BOD=Biochemical Oxygen Demand; TKN=Total Kjeldahl Nitrogen; NH_3N=Ammonia as Nitrogen; NO_2+NO_3= Nitrite plus Nitrate as Nitrogen; TP=Total Phosphorus

Note: All units are in milligrams per liter (mg/L) except temperature (Celsius) and pH (Standard Units)

Appendix F
Excerpt from the Farmington West Construction Permit

C295386-01 Farmington, Missouri Permit No. 2977

CONSTRUCTION PERMIT

Expansion of the wastewater treatment facilities at the Farmington West Plant will increase treatment capacity from 1.2 million gallons per day to 2.4 million gallons per day. The project will include the replacement of headworks components, adding primary clarification, modifying existing aeration basins, adding two additional aeration basins and one final clarifier and adding a new secondary sludge pumping station. A tertiary filter system will be added to decrease solids in the effluent. The ultraviolet disinfection system will be replaced with a higher capacity system. Equipment that will be added to the sludge handling facilities will lime-stabilize biosolids produced at the plant as needed. Sludge storage will be increased by building an enclosure for sludge drying beds that are currently not in use.

Headworks improvements are to include replacement of existing screw pumps, adding a mechanical bar screen, and modifications to the grit chamber area to provide flow to the new primary clarifiers. Two 50-foot diameter primary clarifiers are to be constructed.

All four existing aeration basins will be upgraded with additional aeration equipment and modifications to flow control structures.

Two new 280,586-gallon aeration basins will be constructed to increase the secondary treatment capacity. One new 50-foot diameter final clarifier will be constructed and improvements will be made to existing final clarifiers.

Four 250 square foot travelling bridge tertiary filters will be constructed.

A new ultraviolet disinfection system including a new 31-foot long ultraviolet effluent disinfection channel, ultraviolet light system, and parshall flume effluent measuring device will be constructed.

A lime stabilization system will be added to treat biosolids.

An 8,600 square foot covered storage area will be constructed to store the treated biosolids prior to land application.

Construction at the treatment facility will include modification of existing structures and the addition of pumps, piping, and appurtenances appropriate to the scope and purpose of the project.

All construction at or modifications to the Farmington West Plant during this project shall be in accordance with the approved plans and specifications.